# New Hampshire Volunteer River Assessment Program
# 2005 Piscataquog River Water Quality Report

*Photo: Middle Branch Piscataquog River (00-MIP), Gregg Mill Road, New Boston*

Prepared by:


State of New Hampshire
Department of Environmental Services
Water Division
Watershed Management Bureau


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NEW HAMPSHIRE DEPARTMENT OF
Environmental Services

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# New Hampshire Volunteer River Assessment Program
# 2005 Piscataquog River Water Quality Report

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# ACKNOWLEDGEMENTS

The New Hampshire Department of Environmental Services (NHDES) -Volunteer River Assessment Program (VRAP) extends sincere thanks to the volunteers of the Piscataquog Watershed Association for their efforts during 2005. This report was created solely from the data collected by the volunteers listed below. Their time and dedication is an expression of their genuine concern for local water resources and has significantly contributed to our knowledge of river and stream water quality in New Hampshire.

**2005 Piscataquog River Volunteers**

Paula Bellemore

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# 1. INTRODUCTION

## 1.1. Purpose of Report

Each year the VRAP prepares and distributes a water quality report for each volunteer group that is based solely on the water quality data collected by that volunteer group during a specific year. The reports summarize and interpret the data, particularly as they relate to New Hampshire surface water quality standards, and serve as a teaching tool and guidance document for future monitoring activities by the individual volunteer groups.

## 1.2. Report Format

Each report includes the following:

- **Volunteer River Assessment Program (VRAP) Overview**

  This section includes a discussion of the history of VRAP, the technical support, training and guidance provided by NHDES, and how data is transmitted to the volunteers and used in surface water quality assessments.

- **Monitoring Program Description**

  This section provides a description of the volunteer group's monitoring program including monitoring objectives as well as a table and map showing sample station locations.

- **Results and Discussion**

  Water quality data collected during the year are summarized on a parameter-by-parameter basis using (1) a summary table that includes the number of samples collected, data ranges, the number of samples meeting New Hampshire water quality standards, and the number of samples adequate for water quality assessments at each station, (2) a discussion of the data, (3) a list of applicable recommendations, and (4) a river graph showing the range of measured values at each station. Sample results reported as less than the detection limit were assumed equal to one-half the detection limit on the river graphs. This approach simplifies the understanding of the parameter of interest, and specifically helps one to visualize how the river or watershed is functioning from upstream to downstream. In addition, this format allows the reader to better understand potential pollution areas and target those areas for additional sampling or environmental enhancements. Where applicable, the river graph also shows New Hampshire surface water quality standards or levels of concern for comparison purposes.

- **Appendix A – Data**

  This appendix includes a spreadsheet showing the data results and additional information, such data results which do not meet New Hampshire surface water quality standards, and data that is unusable for assessment purposes due to quality control requirements.

- **Appendix B – Interpreting VRAP Water Quality Parameters**

  This appendix includes a brief description of water quality parameters typically sampled by VRAP volunteers and their importance, as well as applicable state water quality criteria or levels of concern.

- **Appendix C – Glossary of River Ecology Terms**

  This appendix contains a list of terms commonly used when discussing river ecology and water quality.

# 2. PROGRAM OVERVIEW

## 2.1. Past, Present, and Future

In 1998, the New Hampshire Department of Environmental Services (NHDES) initiated the New Hampshire Volunteer River Assessment Program (VRAP) as a means of expanding public education of water resources in New Hampshire. VRAP promotes awareness and education of the importance of maintaining water quality in rivers and streams. VRAP was created in the wake of the success of the existing New Hampshire Volunteer Lake Assessment Program (VLAP), which provides educational and stewardship opportunities pertaining to lakes and ponds to New Hampshire's residents.

Today, VRAP continues to serve the public by providing water quality monitoring equipment, technical support, and educational programs. In 2005, VRAP supported twenty-eight volunteer groups on numerous rivers and watersheds throughout the state. These volunteer groups conduct water quality monitoring on an ongoing basis. The work of the VRAP volunteers increases the amount of river water quality information available to local, state and federal governments, which allows for effective financial resource allocation and watershed planning.

## 2.2. Technical Support

VRAP lends and maintains water quality monitoring kits for volunteer groups throughout the state. The kits contain electronic meters and supplies for "in-the-field" measurements of water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. These are the core parameters typically measured by volunteers. However, other water quality parameters such as nutrients, metals, and *E. coli* can also be studied by volunteer groups, although VRAP does not always provide funds to cover laboratory analysis costs. Thus, VRAP encourages volunteer groups to pursue other fundraising activities such as association membership fees, special events, in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

VRAP typically recommends sampling every other week during the summer, and volunteer groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers design and arrange a sampling schedule in cooperation with NHDES staff. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results, meeting DES Quality Assurance and Quality Control (QA/QC) requirements, supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

## 2.3. Training and Guidance

Each VRAP volunteer attends an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to receive an updated version of monitoring techniques. During the training, volunteers have an opportunity for hand-on use of the VRAP equipment and may also receive instruction in the collection of samples for laboratory analysis. Training is accomplished in approximately two hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment. In some cases, veteran group coordinators can attend a “train the trainer” session. In these trainings the group coordinator receives an update in sampling protocols and techniques and will then train the individual volunteers of their respective group.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. NHDES staff from the VRAP program aim to visit each group annually during a scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group’s monitoring coordinator is notified of the result of the verification visit. VRAP groups forward water quality results to NHDES for incorporation into an annual report and state water quality assessment activities.

## 2.4. Data Usage

### 2.4.1. Annual Water Quality Reports

All data collected by volunteers are summarized in water quality reports that are prepared and distributed after the conclusion of the sampling period (typically fall or winter). Each volunteer group receives copies of the report. The volunteers can use the reports and data as a means of understanding the details of water quality, guiding future sampling efforts, or determining restoration activities.

### 2.4.2. New Hampshire Surface Water Quality Assessments

Along with data collected from other water quality programs, specifically the State Ambient River Monitoring Program, applicable volunteer data are used to support periodic NHDES surface water quality assessments. VRAP data are entered into NHDES’s Environmental Monitoring Database and are ultimately uploaded to the Environmental Protection Agency’s database, STORET.

Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act. The reader is encouraged to log on to the DES web page to review the assessment methodology and list of impaired waters http://www.des.state.nh.us/wmb/swqa/.

## 2.5. Quality Assurance/Quality Control

In order for VRAP data to be used in the assessment of New Hampshire's surface waters, the data must meet quality control guidelines as outlined in the VRAP Quality Assurance Project Plan (QAPP). The VRAP QAPP was approved by NHDES and reviewed by EPA in the summer of 2003. The QAPP is reviewed annually and is officially updated and approved every five years. The VRAP Quality Assurance/Quality Control (QA/QC) measures include a six-step approach to ensuring the accuracy of the equipment and consistency in sampling efforts.

- **Calibration**: Prior to each measurement, the pH and dissolved oxygen meters are calibrated. Conductivity and turbidity meters are calibrated and/or checked against a known standard before the first measurement and after the last one.

- **Replicate Analysis**: A second measurement by each meter is taken from the original sample at one of the stations during the sampling day. The replicate analysis should not be conducted at the same station over and over again, but should be conducted at different stations throughout the monitoring season.

- **6.0 pH Standard**: A reading of the pH 6.0 buffer is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the 6.0 pH standard check should be conducted at different stations.

- **Zero Oxygen Standard**: A reading of a zero oxygen solution is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the zero oxygen standard check should be conducted at different stations.

- **DI Turbidity Blank**: A reading of the DI blank is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the blank check should be conducted at different stations.

- **Post-Calibration**: At the conclusion of each sampling day, all meters are calibrated.

### 2.5.1. Measurement Performance Criteria

Precision is calculated for field and laboratory measurements through measurement replicates (instrumental variability) and is calculated for each sampling day. The use of VRAP data for assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as derived from equation 1, below. Any data exceeding the limits of the individual measures are disqualified from surface water quality assessments. All data that exceeds the limits defined by the VRAP QAPP are acknowledged in the data tables with an explanation of why the data was unusable. Table 1 shows typical parameters studied under VRAP and the associated quality control procedures.

(Equation 1)

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100 \ \%$$

where $x_1$ is the original sample and $x_2$ is the replicate sample

**Table 1. Field Analytical Quality Controls**

| Water Quality Parameter | QC Check | QC Acceptance Limit | Corrective Action | Person Responsible for Corrective Action | Data Quality Indicator |
|---|---|---|---|---|---|
| Temperature | Measurement replicate | ± 0.2 °C | Repeat measurement | Volunteer Monitors | Precision |
| Dissolved Oxygen | Measurement replicate | ± 2% of saturation, or ± 0.2 mg/L | Recalibrate instrument, repeat measurement | Volunteer Monitors | Precision |
| | Known buffer (zero $O_2$ solution) | <0.5 mg/L | Recalibrate instrument, repeat measurement | Volunteer Monitors | Relative accuracy |
| pH | Measurement replicate | ± 0.1 std units | Recalibrate instrument, repeat measurement | Volunteer Monitors | Precision |
| | Known buffer (pH = 6.0) | ± 0.1 standard units | Recalibrate instrument repeat measurement | Volunteer Monitors | Accuracy |
| Specific Conductance | Measurement replicate | ± 30 µS/cm | Recalibrate instrument, repeat measurement | Volunteer Monitors | Precision |
| | Method blank (Zero air reading) | ± 5.0 µS/cm | Recalibrate instrument, repeat measurement | Volunteer Monitors | Accuracy |
| Turbidity | Measurement replicate | ± 0.1 NTU | Recalibrate instrument, repeat measurement | Volunteer Monitors | Precision |
| | Method blank (DI Water) | ± 0.1 NTU | Recalibrate instrument, repeat measurement | Volunteer Monitors | Accuracy |

# 3. METHODS

During the summer of 2002 the Piscataquog River Watershed Association (PWA) initiated a volunteer water quality sampling program in the Piscataquog River watershed. The goal of this effort was to provide water quality data from the Piscataquog River watershed relative to surface water quality standards and to allow for the assessment of the river for support of aquatic life and primary contact recreation (swimming). The establishment of a long-term monitoring program will allow for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, equipment, financial aid for laboratory costs, and technical assistance.

During 2005, trained volunteers from the PWA monitored water quality at 18 stations in the Piscataquog River watershed (Figure 1, Table 2). Stations IDs are designated using a three letter code to identify the waterbody name plus a number indicating the relative position of the station. The higher the station number the more upstream the station is in the watershed. All waterbodies monitored in 2005 are designated as Class B waters.

Water quality monitoring was conducted from May to September. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using handheld meters provided by NHDES. Samples for *E. coli* were taken using sterile bottles supplied by the NHDES laboratory and were stored on ice during transport from the field to the lab. Table 3 summarizes the parameters measured, laboratory standard methods, and equipment used.

**Table 2. Sampling Stations - Piscataquog River Watershed, NHDES VRAP, 2005**

| Station ID | Waterbody Name | Location | Town | Elevation* |
|---|---|---|---|---|
| **01K-MIP** | **Middle Branch - Piscataquog River** | Route 77 Bridge | New Boston | 400 |
| **00-MIP** | **Middle Branch - Piscataquog River** | Gregg Mill Road | New Boston | 300 |
| **01-BRN** | **Brennan Brook** | Clarkville Road Bridge | Francestown | 700 |
| **01-RND** | **Rand Brook** | Russell Station Road Bridge | Francestown | 600 |
| **01-CDB** | **Cold Brook** | Francestown Tpk. Bridge | New Boston | 600 |
| **05-SOP** | **South Branch - Piscataquog River** | Lyndeborough Road Bridge Ist Crossing | New Boston | 400 |
| **04-SOP** | **South Branch - Piscataquog River** | Lyndeborough Road Bridge 2nd Crossing | New Boston | 400 |
| **03D-SOP** | **South Branch - Piscataquog River** | Route 13 Bridge | New Boston | 400 |
| **02-SOP** | **South Branch - Piscataquog River** | Depot Street Bridge | New Boston | 400 |
| **01K-SOP** | **South Branch - Piscataquog River** | 50 Feet Upstream of Confluence w/ Clear Brook | New Boston | 400 |
| **09P-PQG** | **Piscataquog River** | Route 149 Crossing | Deering | 700 |
| **09M-PQG** | **Piscataquog River** | Horrace Bridge | Weare | 600 |
| **09K-PQG** | **Piscataquog River** | John Connor Road Bridge | Weare | 600 |
| **09H-PQG** | **Piscataquog River** | Route 77/Center Street Bridge | Weare | 500 |
| **07-PQG** | **Piscataquog River** | Parker Road Bridge | New Boston | 300 |
| **03Y-PQG** | **Piscataquog River** | Grassmere Bridge | Goffstown | 200 |
| **03G-PQG** | **Piscataquog River** | Hillsborough County Farm | Goffstown | 200 |
| **01B-PQG** | **Piscataquog River** | Bass Island-Western Tip | Manchester | 100 |

*Elevations have been rounded off to 100-foot increments for calibration of dissolved oxygen meter

**Figure 1. Piscataquog River Watershed and Monitoring Stations 2005**

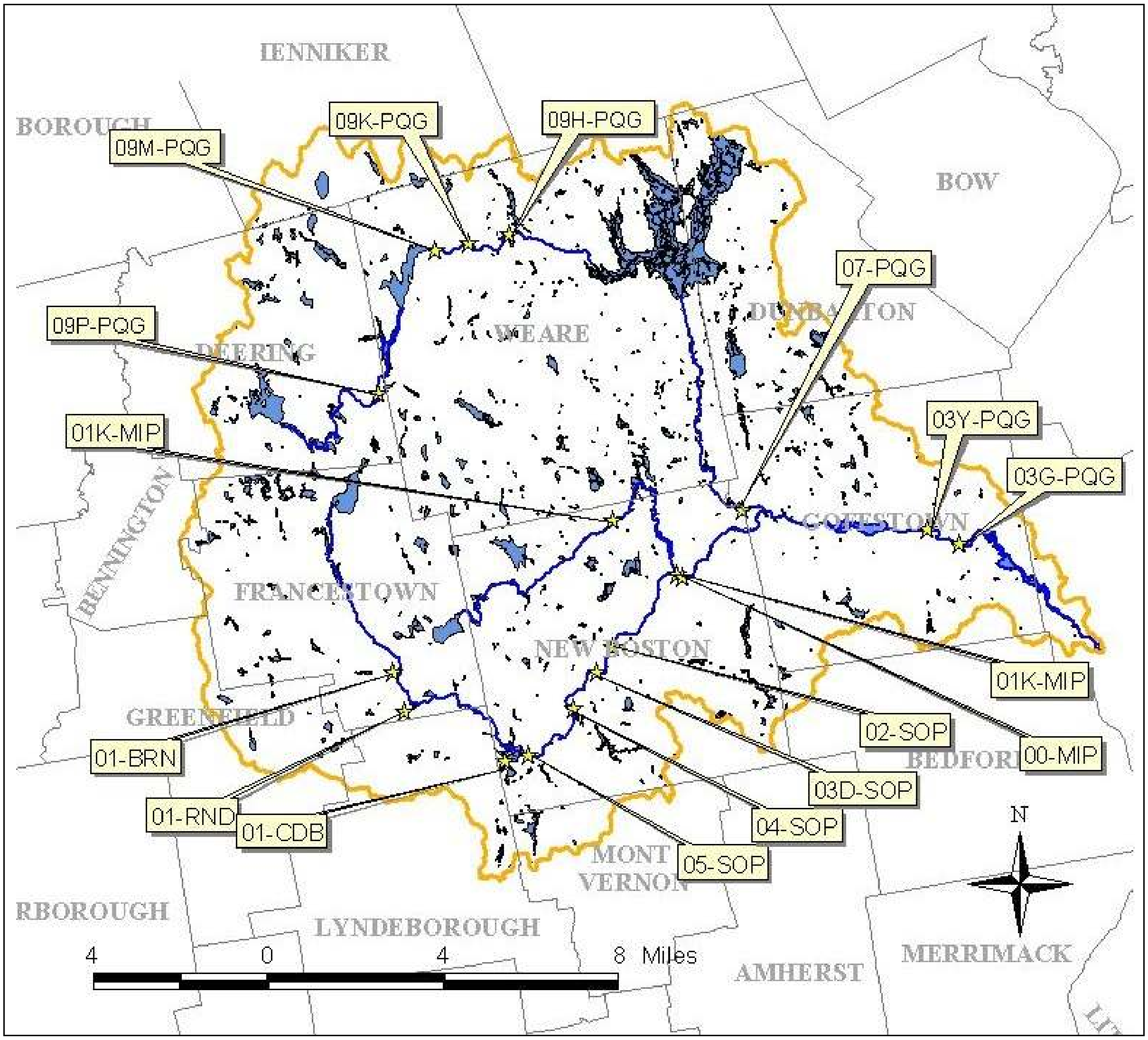



**Table 3. Sampling and Analysis Methods**

| Parameter | Sample Type | Standard Method | Equipment Used | Laboratory |
|---|---|---|---|---|
| Temperature | In-Situ | SM 2550 | YSI 95 | ------ |
| Dissolved Oxygen | In-Situ | SM 4500 O G | YSI 95 | ------ |
| pH | In-Situ | SM 4500 H+ | Orion 210A+ | ------ |
| Turbidity | In-Situ | EPA 180.1 | Lamotte 2020 | ------ |
| Specific Conductance | In-Situ | SM 2510 | YSI 30 | ------ |
| E. coli | Bottle (Sterile) | SM 19 9213 D.3 | ------ | NHDES |

# 4. RESULTS AND DISCUSSION

## 4.1. Dissolved Oxygen

Between one and five measurements were taken in the field for dissolved oxygen concentration at 12 stations within the Piscataquog River watershed. (Table 4). Of the 31 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. VRAP staff also deployed submersible dataloggers to record dissolved oxygen at six stations within the Piscataquog River watershed.

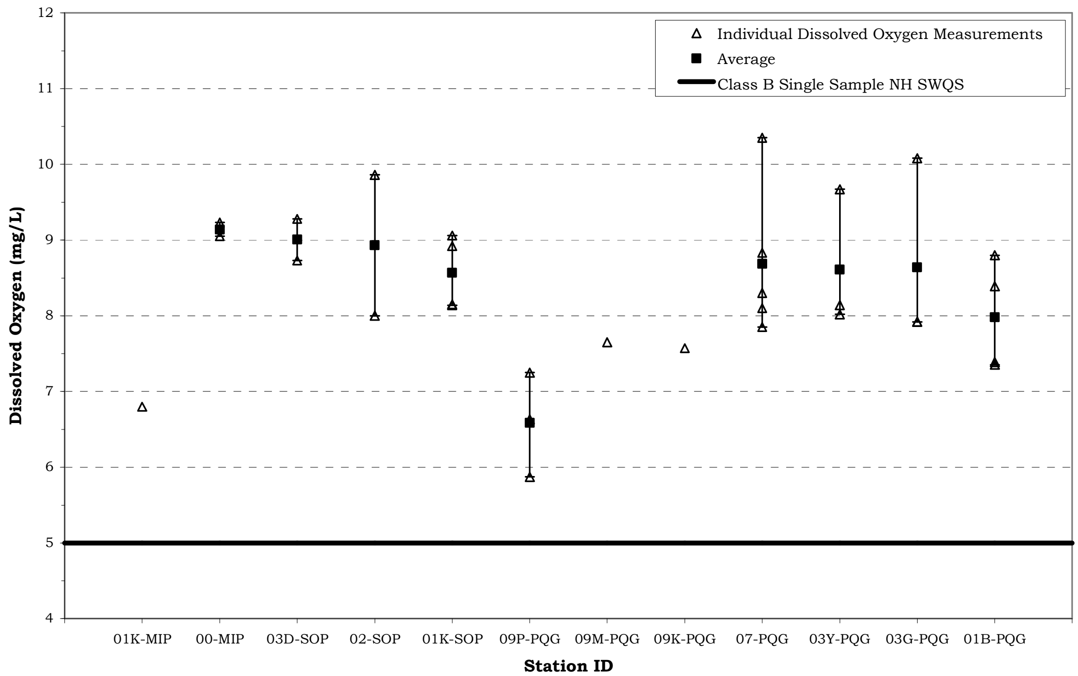
The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting dissolved oxygen standards. Table 4 reports only dissolved oxygen concentration as more detailed analysis is required to determine if instantaneous dissolved oxygen saturation measurements are above or below water quality standards.

**Table 4. Dissolved Oxygen Concentration Data Summary – Piscataquog River, 2005**

| Station ID | Samples Collected | Data Range (mg/l) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 01K-MIP | 1 | 6.80 | 0 | 1 |
| 00-MIP | 2 | 9.05 - 9.23 | 0 | 2 |
| 03D-SOP | 2 | 8.73 - 9.28 | 0 | 2 |
| 02-SOP | 2 | 8.00 - 9.86 | 0 | 2 |
| 01K-SOP | 4 | 8.14 - 9.06 | 0 | 4 |
| 09P-PQG | 3 | 5.87 - 7.25 | 0 | 3 |
| 09M-PQG | 1 | 7.65 | 0 | 1 |
| 09K-PQG | 1 | 7.57 | 0 | 1 |
| 07-PQG | 5 | 7.85 - 10.35 | 0 | 5 |
| 03Y-PQG | 3 | 8.02 - 9.67 | 0 | 3 |
| 03G-PQG | 3 | 7.92 - 10.08 | 0 | 3 |
| 01B-PQG | 4 | 7.35 - 8.80 | 0 | 4 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **31** |

Dissolved oxygen concentration levels were above state standards on all occasions and at all stations (Figure 2). The average concentration of dissolved oxygen was consistently above the Class B standard at all stations ranging from 6.58 mg/L to 9.14 mg/L. Levels of dissolved oxygen sustained above the standards are considered adequate for the support of aquatic life and other desirable water quality conditions.

**Figure 2. Dissolved Oxygen Statistics for the Piscataquog River**
**July 14 - September 21, 2005, NHDES VRAP**




Figures 3 through 6 illustrate the results of dissolved oxygen saturation and concentration levels obtained at six stations in the Piscataquog River watershed using submersible dataloggers. The data was collected on two separate occasions where dataloggers were deployed. On both occasions, meters were programmed to take dissolved oxygen readings every 30 minutes. Data from these meters is generally analyzed in 24 hour sections.

During the first deployment three dataloggers were deployed with one each on the mainstem (09M-PQG), Middle Branch (00-MIP), and South Branch (05-SOP) of the Piscataquog River.  During the deployment (7/14/05 – 7/18/05) three full 24-hour periods were measured. The daily average of dissolved oxygen % saturation was above the Class B standard of 75% at all three stations on all days (Figure 3). Dissolved oxygen concentration levels were above the Class B standard of 5.0 mg/L on all occasions at all three stations (Figure 4).

During the second deployment, one datalogger was placed in the mainstem of the Piscataquog River (09H-PQG) and three dataloggers were placed in tributaries to the South Branch Piscataquog River; Brennan Brook (01-BRN), Cold Brook (01-CDB), and Rand Brook (01-RND). During this deployment (7/21/05 – 7/26/05) four full 24-hour periods were measured. The daily average of dissolved oxygen % saturation was above the Class B standard of 75% at all three stations on all days (Figure 5). Dissolved oxygen concentration levels were above the Class B standard of 6.0 mg/L on all occasions at all three stations (Figure 6).

**Figure 3. Dissolved Oxygen Saturation Statistics for the Piscataquog River**
**July 14 - 18, 2005, NHDES VRAP**

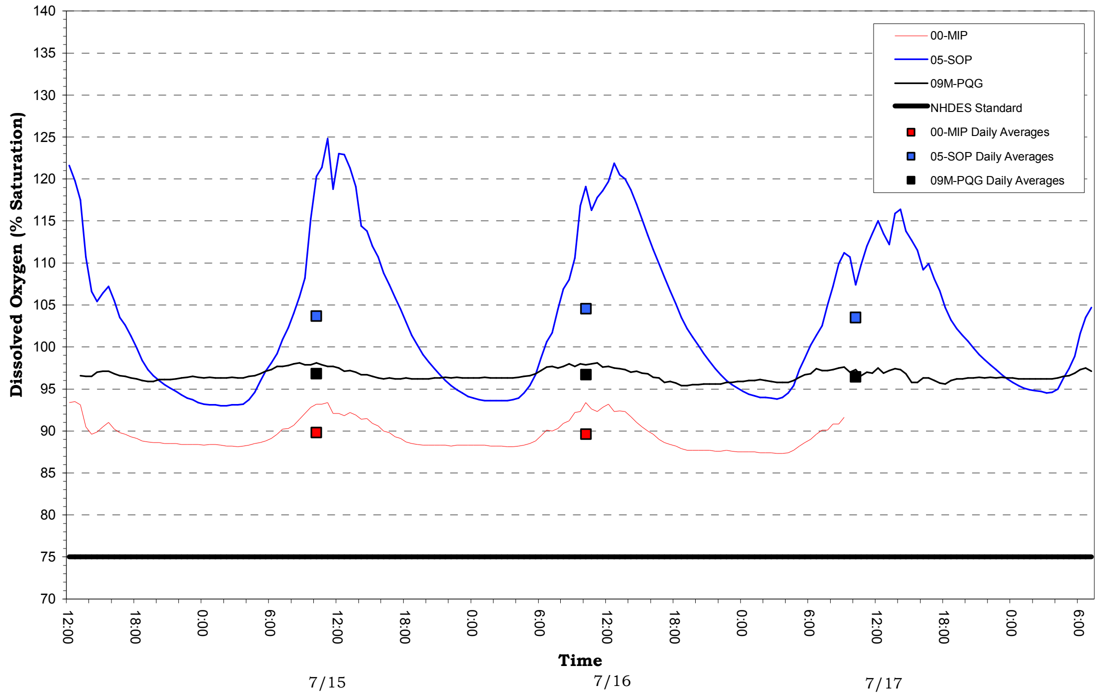



**Figure 4. Dissolved Oxygen Concentration Statistics for the Piscataquog**
**July 14 - 18, 2005, NHDES VRAP**

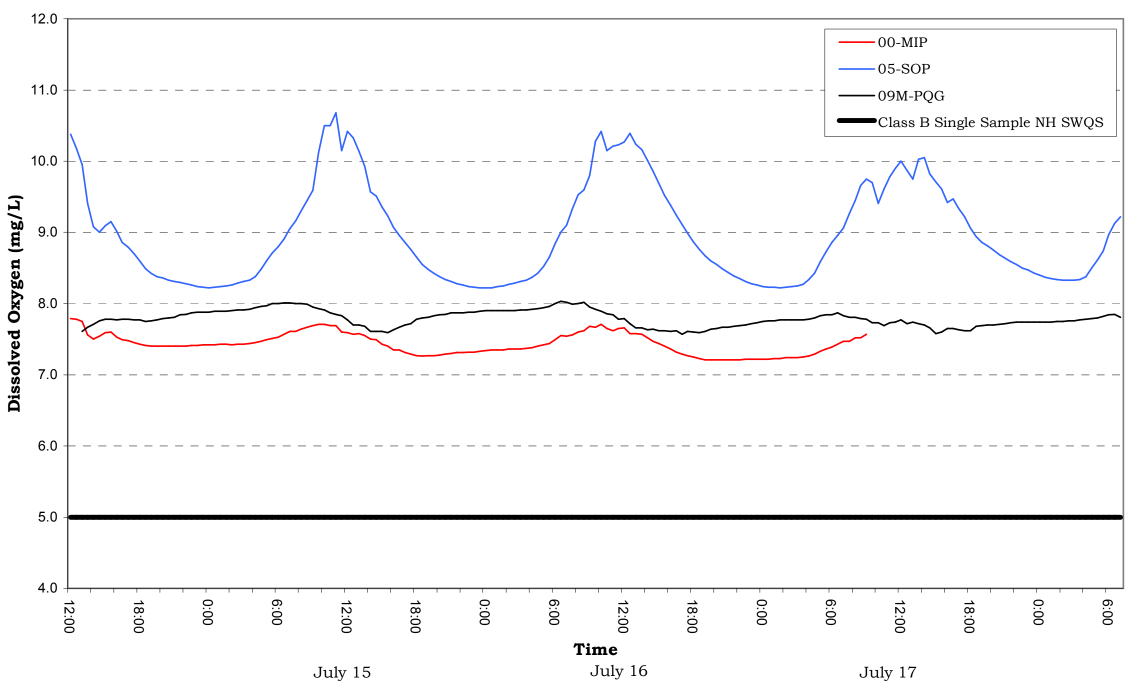


**Figure 5. Dissolved Oxygen Saturation Statistics for the Piscataquog River**
**July 21 - 26, 2005, NHDES VRAP**

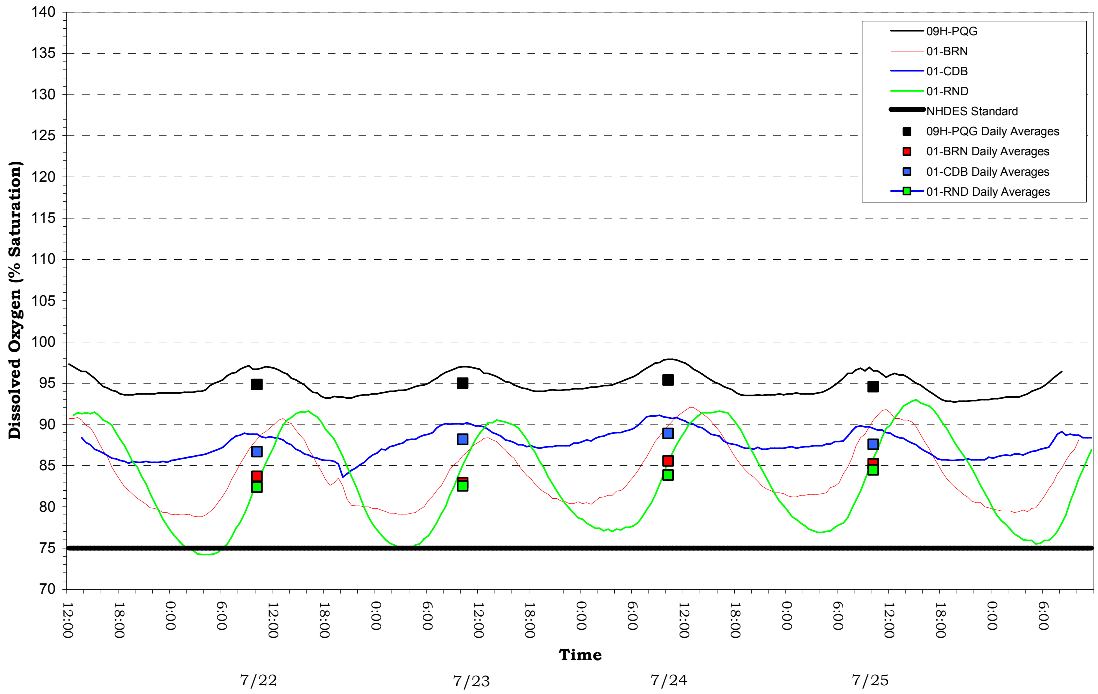
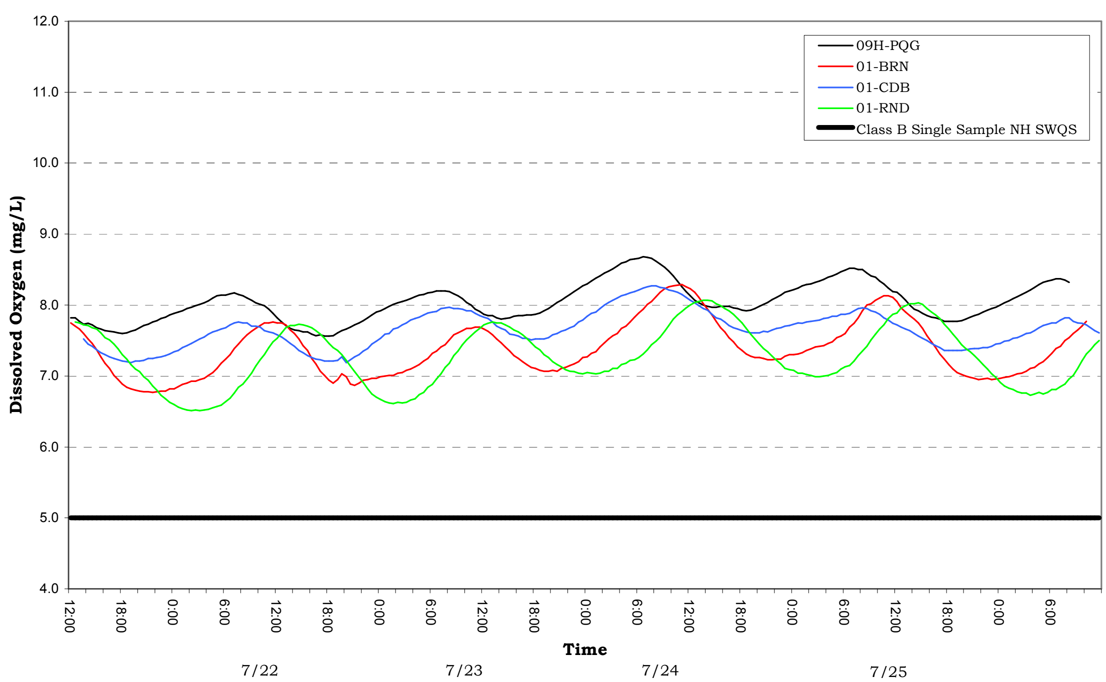



**Figure 6. Dissolved Oxygen Concentration Statistics for the Piscataquog**
**July 21 - 26, 2005, NHDES VRAP**



Dissolved oxygen data in Figure 3 through Figure 6 also depict the typical cyclical variations in dissolved oxygen measurements one would expect to see during a 24-hour period in the summer. In general, dissolved oxygen levels are lowest in the early morning when there is low photosynthetic activity and a peak in respiration from organisms throughout the water column. This is the time of least oxygen production and greatest carbon dioxide emission. Peak dissolved oxygen levels occur when photosynthetic activity is at its peak. The greater the amount of photosynthetic activity the greater the production of oxygen as a byproduct of photosynthesis.

Day and night levels of dissolved oxygen levels at station 05-SOP varied significantly more than other stations. The type and amount of plants and algae present in a waterbody can significantly impact dissolved oxygen levels. If many plants are present, the water can become supersaturated with dissolved oxygen during the day as photosynthesis occurs. Dissolved oxygen levels can then decrease significantly during the night when respiration is at its peak. The large daytime/nighttime swing in dissolved oxygen levels at 05-SOP indicates a high presence of plants and/or algae in this section of the South Branch. This could be due to natural conditions such as the wetlands upstream of this station or could be a symptom of higher nutrient levels.

## Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- If possible, take measurements between 5:00 a.m. and 10:00 a.m., which is when dissolved oxygen is usually the lowest, and between 2:00 p.m. and 7:00 p.m. when dissolved oxygen is usually the highest. In general, dissolved oxygen levels are lowest in the early morning when there is low photosynthetic activity and a peak in respiration from organisms throughout the water column. This is the time of least oxygen production and greatest carbon dioxide emission. Peak dissolved oxygen levels occur when photosynthetic activity is at its peak. The greater the amount of photosynthetic activity the greater the production of oxygen as a byproduct of photosynthesis.
- Continue to incorporate the use of in-situ dataloggers to automatically record dissolved oxygen saturation levels during a period of several days. This will allow for the calculation of the daily average for dissolved oxygen per cent saturation. The use of these instruments is dependent upon availability, and requires coordination with NHDES.

## 4.2. pH

Between one and five measurements were taken in the field for pH at 12 stations within the Piscataquog River watershed [Table 5]. Of the 29 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. VRAP staff also deployed submersible dataloggers to record pH at six stations within the Piscataquog River watershed.

The Class B New Hampshire surface water quality standard is 6.5 - 8.0, unless naturally occurring.

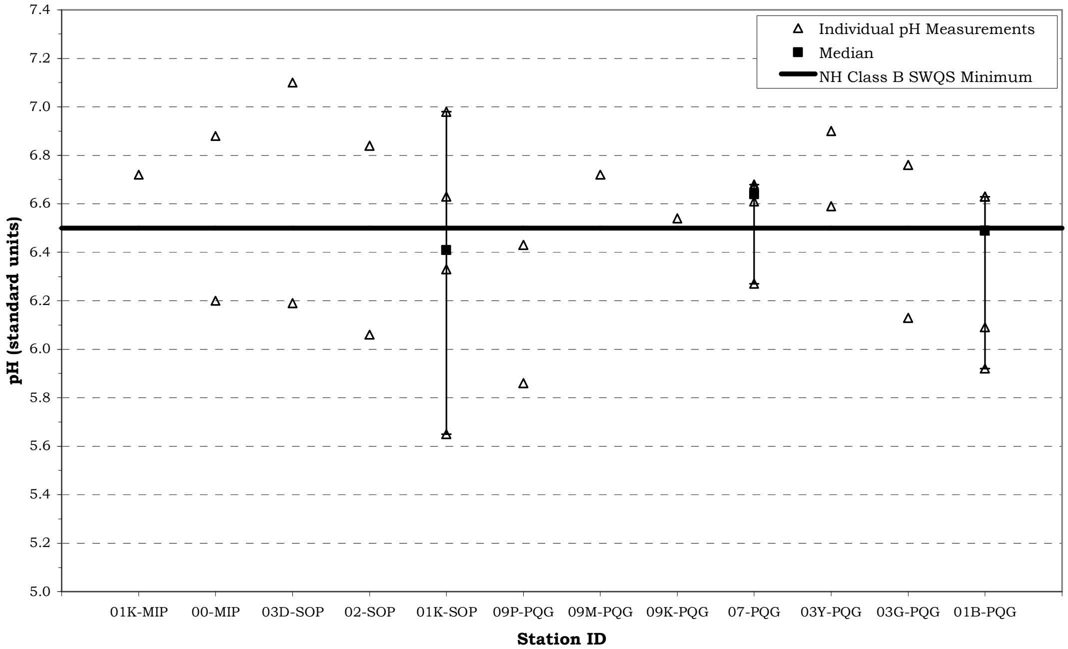
**Table 5. pH Data Summary – Piscataquog River, 2005**

| Station ID | Samples Collected | Data Range (standard units) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| **01K-MIP** | 1 | 6.72 | 0 | 1 |
| **00-MIP** | 2 | 6.20 - 6.88 | 0 | 2 |
| **03D-SOP** | 2 | 6.19 - 7.10 | 1 | 2 |
| **02-SOP** | 2 | 6.06 - 6.84 | 1 | 2 |
| **01K-SOP** | 5 | 5.65 - 6.98 | 2 | 5 |
| **09P-PQG** | 2 | 5.86 - 6.43 | 2 | 2 |
| **09M-PQG** | 1 | 6.72 | 0 | 1 |
| **09K-PQG** | 1 | 6.54 | 0 | 1 |
| **07-PQG** | 4 | 6.27 - 6.68 | 1 | 4 |
| **03Y-PQG** | 2 | 6.59 - 6.90 | 0 | 2 |
| **03G-PQG** | 2 | 6.13 - 6.76 | 1 | 2 |
| **01B-PQG** | 5 | 5.92 - 6.63 | 2 | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **29** |

A majority of the pH measurements on the Piscataquog River were within the range of the New Hampshire surface water quality standard (Figure 7) though several stations had occasions where the pH was below the standard.

Lower pH measurements are likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. Rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels; after the spring melt or significant rain events, surface waters will generally have a lower pH.

**Figure 7. pH Statistics for the Piscataquog River**
**July 14 - September 21, 2005, NHDES VRAP**




Figures 8 and 9 illustrate the results of pH measurements obtained at six stations in the Piscataquog River watershed using submersible dataloggers. The meters were programmed to take pH readings every 30 minutes over a multiple day period. During this deployment four full 24-hour periods were measured. In general, the daily minimum pH is used to determine if the waterbodies are meeting surface water quality standards.

**Figure 8. pH Statistics for the Piscataquog River**
**July 14 - 18, 2005, NHDES VRAP**

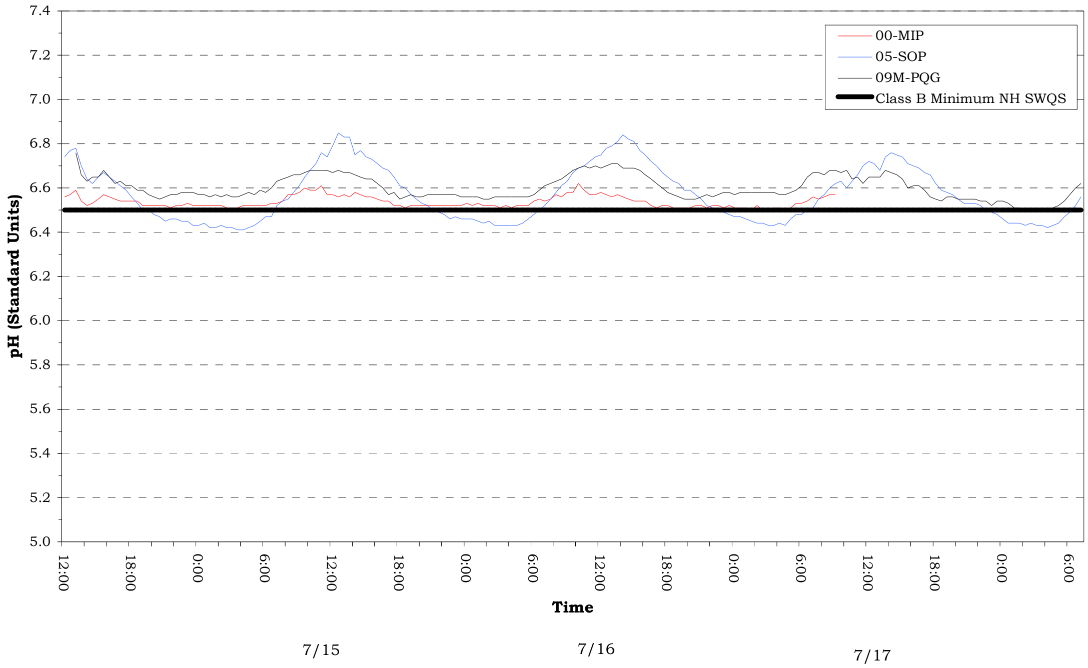
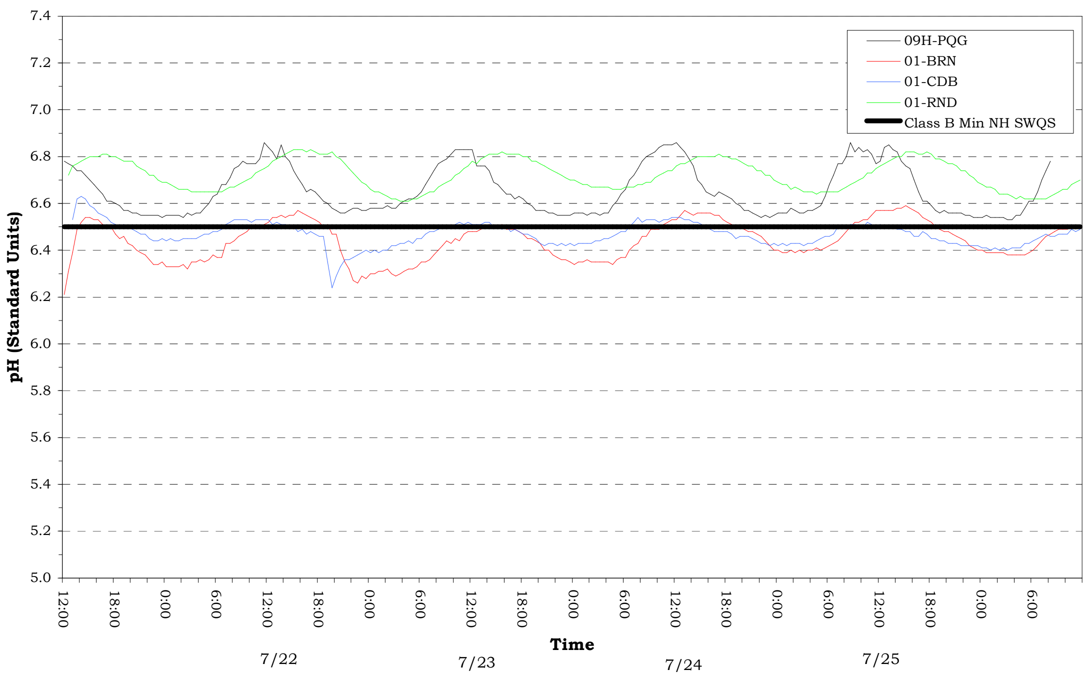



**Figure 9. pH Statistics for the Piscataquog River**
**July 21 - 26, 2005, NHDES VRAP**



Four of the stations (09M-PQG, 09H-PQG, 00-MIP, and 01-RND) had pH measurements that were always below the standard. Stations 05-SOP, 01-BRN, and 01-CDB had pH measurements both above and below the standard.

## Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

- Consider sampling for pH in some of the tributaries and wetland areas that are influencing the pH of stations with measurements below state standards. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes.* Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

## 4.3. Turbidity

Between two and seven measurements were taken in the field for turbidity at 12 stations within the Piscataquog River watershed [Table 6]. Of the 41 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

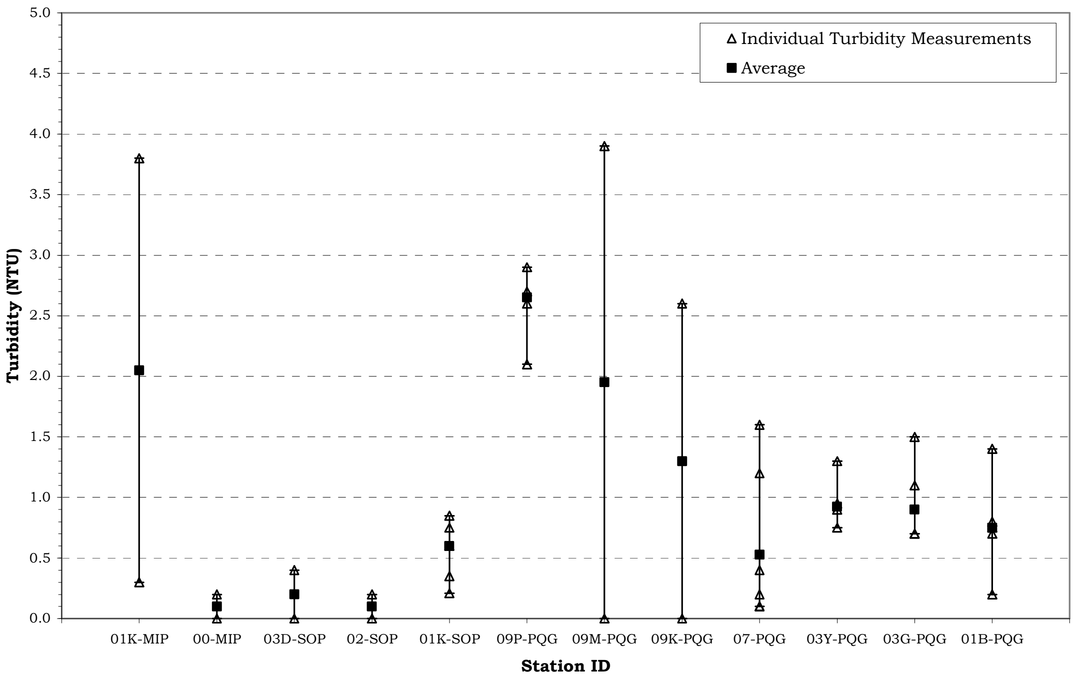
The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above background.

**Table 6. Turbidity Data Summary - Piscataquog River, 2005**

| Station ID | Samples Collected | Data Range (NTU) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| **01K-MIP** | 2 | 0.3 - 3.8 | 0 | 2 |
| **00-MIP** | 2 | 0.0 - 0.2 | 0 | 2 |
| **03D-SOP** | 2 | 0.0 - 0.4 | 0 | 2 |
| **02-SOP** | 2 | 0.0 - 0.2 | 0 | 2 |
| **01K-SOP** | 5 | 0.2 - 0.9 | 0 | 5 |
| **09P-PQG** | 4 | 2.1 - 2.9 | 0 | 4 |
| **09M-PQG** | 2 | 0.0 - 3.9 | 0 | 2 |
| **09K-PQG** | 2 | 0.0 - 2.6 | 0 | 2 |
| **07-PQG** | 7 | 0.1 - 1.6 | 0 | 7 |
| **03Y-PQG** | 4 | 0.8 - 1.3 | 0 | 4 |
| **03G-PQG** | 4 | 0.7 - 1.5 | 0 | 4 |
| **01B-PQG** | 5 | 0.2 - 1.4 | 0 | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **41** |

Turbidity levels were low on all occasions and at all stations with the average ranging from 0.1 NTU to 2.7 NTU (Figure 10). Although clean waters are associated with low turbidity there is a high degree of natural variability involved. Precipitation often contributes to increased turbidity by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. However, human activities such as removal of vegetation near surface waters and disruption of nearby soils can lead to dramatic increases in turbidity levels. In general it is typical to see a rise in turbidity in more developed areas due to increased runoff.

**Figure 10. Turbidity Statistics for the Piscataquog River**
**July 14 - September 21, 2005, NHDES VRAP**




## Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

- Collect samples during wet weather. This will help us to understand how the river responds to runoff and sedimentation.

- If a higher than normal turbidity measurement occurs, volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated turbidity levels. In addition, take good field notes and photographs. If human activity is suspected or verified as the source of elevated turbidity levels volunteers should contact NHDES.

## 4.4. Specific Conductance

Between two and seven measurements were taken in the field for specific conductance at 12 stations within the Piscataquog River watershed [Table 7]. Of the 41 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. VRAP staff also deployed submersible dataloggers to record specific conductance at six stations within the Piscataquog River watershed.

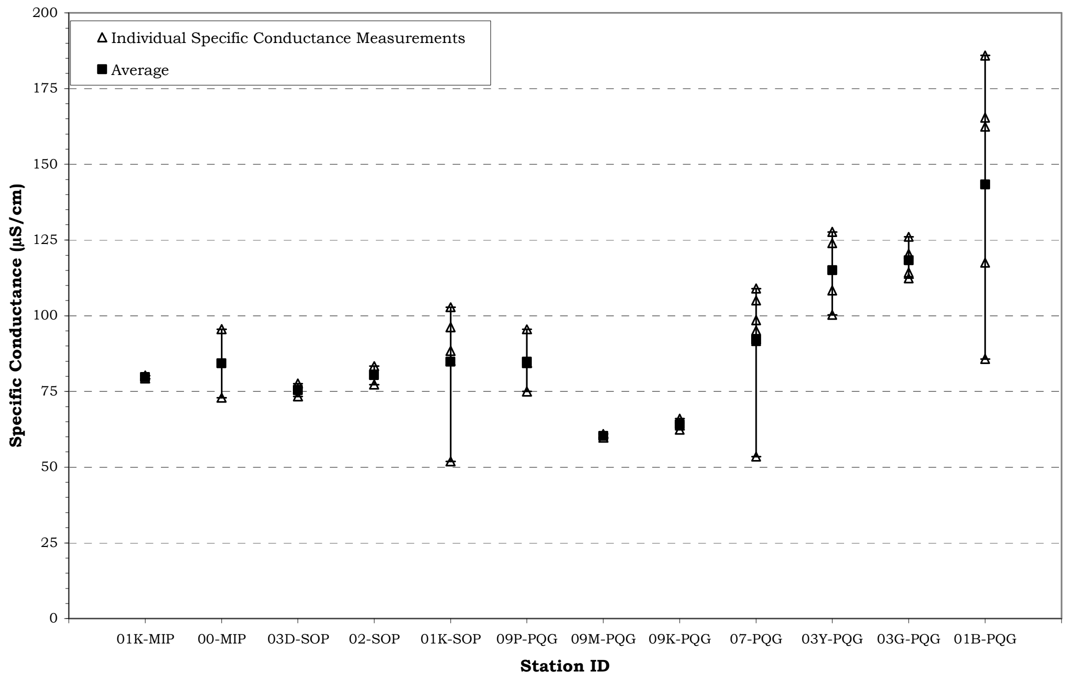
New Hampshire surface water quality standards do not contain numeric limits for specific conductance.

**Table 7. Specific Conductance Data Summary - Piscataquog River, 2005**

| Station ID | Samples Collected | Data Range (µS/cm) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| **01K-MIP** | 2 | 79.3 - 80.2 | Not Applicable | 2 |
| **00-MIP** | 2 | 72.9 - 95.6 | N/A | 2 |
| **03D-SOP** | 2 | 73.3 - 77.6 | N/A | 2 |
| **02-SOP** | 2 | 77.3 - 83.4 | N/A | 2 |
| **01K-SOP** | 5 | 51.9 - 102.8 | N/A | 5 |
| **09P-PQG** | 4 | 75.0 - 95.5 | N/A | 4 |
| **09M-PQG** | 2 | 59.8 - 60.9 | N/A | 2 |
| **09K-PQG** | 2 | 62.3 - 66.0 | N/A | 2 |
| **07-PQG** | 7 | 53.5 - 109.0 | N/A | 7 |
| **03Y-PQG** | 4 | 100.3 - 127.7 | N/A | 4 |
| **03G-PQG** | 4 | 112.4 - 126.1 | N/A | 4 |
| **01B-PQG** | 5 | 85.7 - 185.9 | N/A | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **41** |

Specific conductance levels were variable along the entire reach of the river (Figure 11) with the average ranging from 60 µS/cm to 143 µS/cm. Higher specific conductance levels can be indicative of pollution from sources such as urban/agricultural runoff, road salt, failed septic systems, or groundwater pollution. The variable specific conductance levels in the Piscataquog River watershed indicate low pollutant levels at some stations and potentially higher levels at others.

**Figure 11. Specific Conductance Statistics for the Piscataquog River**
**July 14 - September 21, 2005, NHDES VRAP**




Figures 12 and 13 illustrate the results of specific conductance measurements obtained at six stations in the Piscataquog River watershed using submersible dataloggers. The meters were programmed to take specific conductance readings every 30 minutes. At all six stations, specific conductance levels were relatively low and where applicable consistent with the instantaneous measurements taken throughout 2005.

**Figure 12. Specific Conductance Statistics for the Piscataquog River**
**July 14 - 18, 2005, NHDES VRAP**

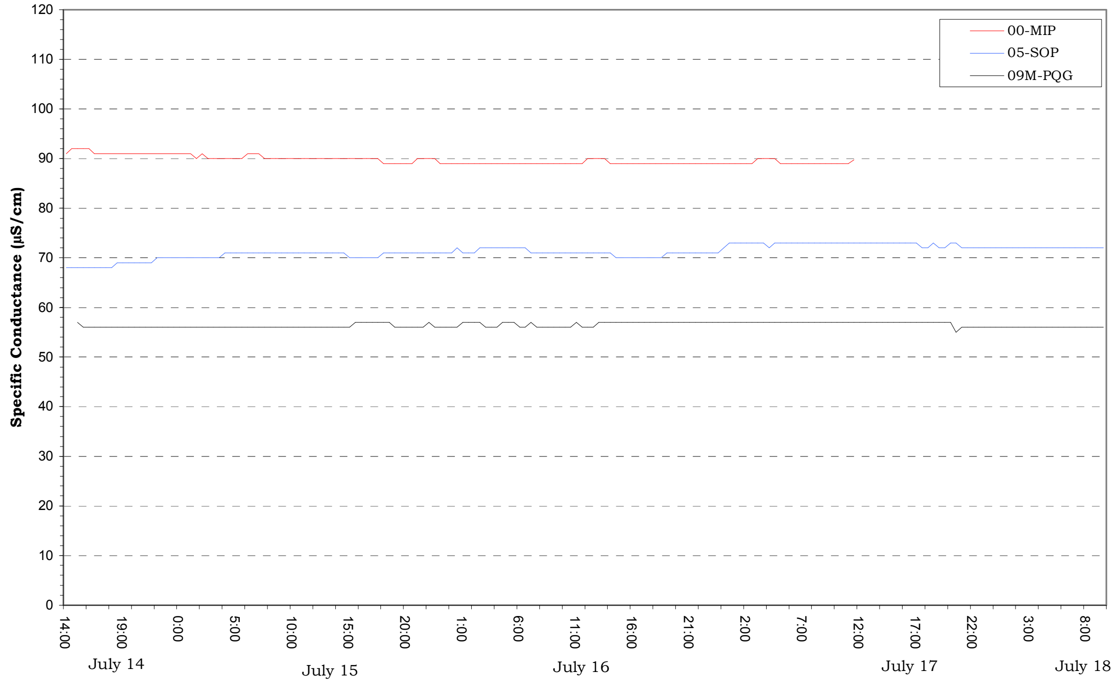
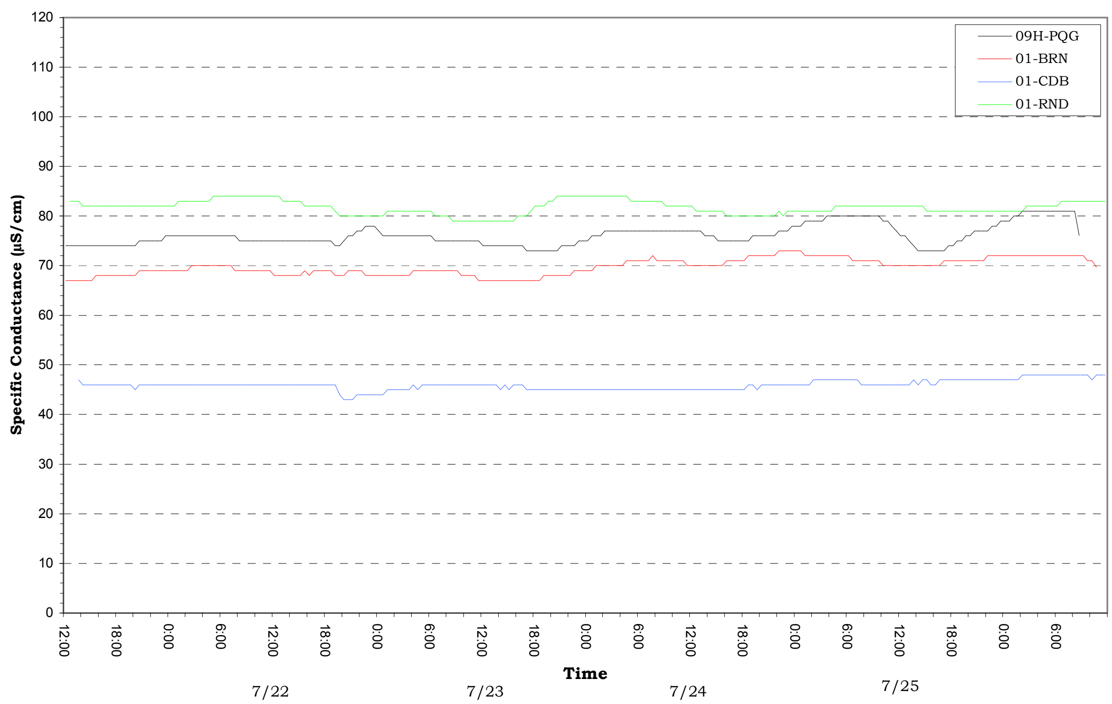



**Figure 13. Specific Conductance Statistics for the Piscataquog River**
**July 21 - 26, 2005, NHDES VRAP**



## Recommendations

- ❖ Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

- ❖ Consider collecting chloride samples at the same time specific conductance is measured. During the late winter/early spring snowmelt, higher conductivity levels are often seen due to elevated concentrations of chloride in the runoff. Conductivity levels are very closely correlated to chloride levels. Simultaneously measuring chloride and conductivity will allow for a better understanding of their relationship.

## 4.5. Escherichia coli/Bacteria

Three samples were collected for *Escherichia coli* (*E. coli*) at five stations within the Piscataquog River watershed [Table 5-5]. All measurements met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency.

Class B NH surface water quality standards for *E.coli* are as follows:

<406 cts/100 ml, based on any single sample, or
<126 cts/100 ml, based on a geometric mean calculated from three samples collected within a 60-day period.

**Table 8. *E. coli* Data Summary for the Piscataquog River, 2005**

| Station ID | Samples Collected | Data Range (cts/100ml) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| **00-MIP** | 3 | 20 - 40 | 0 | 3 |
| **04-SOP** | 3 | 10 - 70 | 0 | 3 |
| **02-SOP** | 3 | 90 - 270 | 0 | 3 |
| **09M-PQG** | 3 | <10 - 10 | 0 | 3 |
| **09H-PQG** | 3 | 90 - 240 | 0 | 3 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **15** |

None of the stations tested for *E.coli* had single sample levels which exceeded the New Hampshire surface water quality standard (Figure 14). In order to fully determine whether a waterbody is meeting surface water standards for *E.coli* a geometric mean must be calculated. A geometric mean is calculated using three samples collected within a 60-day period. At all five stations a geometric mean was calculated. Stations 02-SOP and 09H-PQG had geometric means that were above the standard of 126 cts/100ml (Table 9).

Several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife (e.g., birds), and the presence of septic systems along the river.

**Figure 14. *Escherichia coli* Statistics for the Piscataquog River**
**July 14 - September 2, 2005, NHDES VRAP**

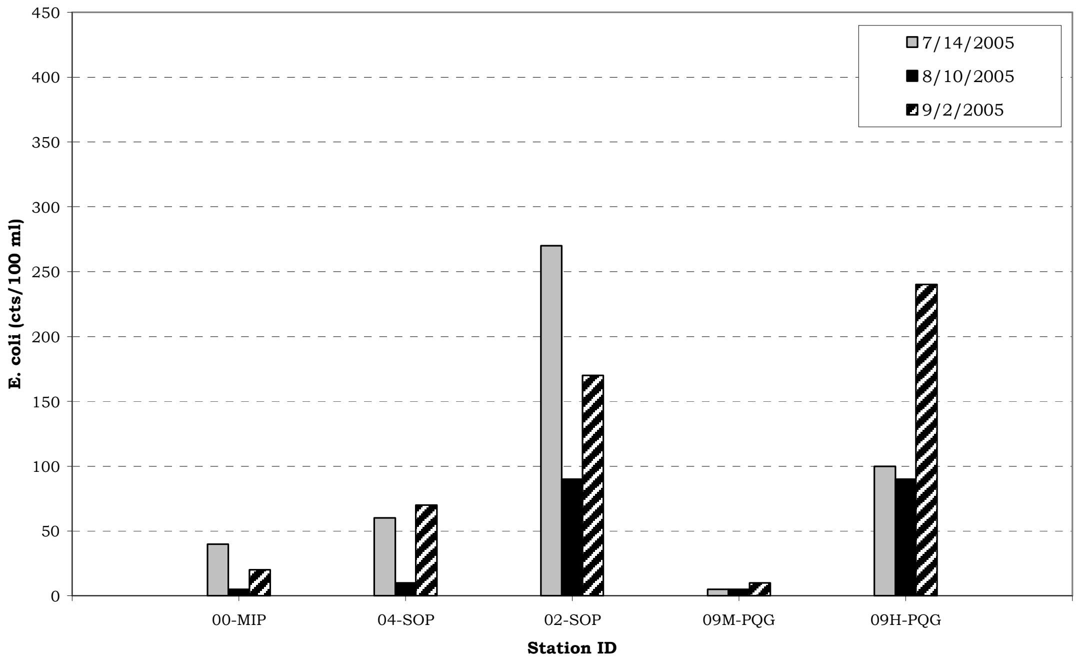



**Table 9. *E. coli* Geomean Data Summary - Piscataquog River, 2005**

| Station ID | Geometric Mean 7/14/05 - 9/2/05 | Geometric Means Not Meeting NH Class B Standards |
|---|---|---|
| **00-MIP** | 28 | 0 |
| **04-SOP** | 35 | 0 |
| **02-SOP** | 160 | 1 |
| **09M-PQG** | 10 | 0 |
| **09H-PQG** | 129 | 1 |

## Recommendations

- ❖ Continue to collect three samples at each station within any 60-day period during the summer to allow for determination of geometric means.

- ❖ Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).

- ❖ If a high bacteria count is measured, volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated bacteria levels. Those sampling should also look for any potential sources of bacteria such as emission pipes and failed septic systems.

- ❖ Continue working with the Volunteer River Assessment Program and NHDES to identify any illicit discharges into the watershed that may be causing high bacteria levels.

# APPENDIX A

## 2005 Piscataquog River Water Quality Data

# APPENDIX B

# Interpreting VRAP Water Quality Parameters

# APPENDIX C

## Glossary of River Ecology Terms